CHAPTER III

RESEARCH METHODS

3.1 Research Design

This study was of the mixed method design. The quantitative part was of the crossover repeated measure design (Class A) and the non-equivalent control group design was adopted for both classes A and B. The crossover repeated measure was chosen because participants served as their own control and this reduced influences of unexpected covariates (El-Banna et al., 2017). The qualitative method addressed students' perceptions with regards to the instructional pedagogy and the quantitative part of the mixed method focused on the student achievement (in terms of grades) after the adoption of as flipped classroom model. The study was conducted in 8 weeks (see figure 3.1). The twin instructional pedagogies were successively applied to the principles of electrical engineering course offered under the Electrical engineering first degree at Indonesia University of Education. The course is offered in the first semester of each and every academic year to all first-year

students taking a Bachelor's degree in Electrical Engineering.

Table 3.1. Quasi Experimental Design.

	Pre-test	Intervention	Post-test
Class A	Baseline Survey	Flipped Model	Evaluation Survey
Class B	-	Traditional Model	Evaluation Survey

3.2 Participants, Sample and Population

The participants were electrical engineering students, course lecturers and the researcher. The population was composed of 156 enrolled students at Indonesia University of Education. 64 students participated in the study. These were divided into two homogeneous classes. Class A and B were equally composed of 32 students. Both classes were taught by one lecturer with vast experience. Additionally, there was an assistant lecturer. 11 (17%) of the participants were females while 53 (83%) were males. The mean age of the participants was 18 years. The researcher conveniently chose the two electrical engineering classes and deliberately excluded the other two classes. The following determinants

were also considered before picking up the sample classes; student' internet self-efficacy, computer self-efficacy and online communication self-efficacy. Most students had access to internet at campus and their respective residences. However, some participants had little experience with self-directed learning.

3.3 Data Collection

3.3.1 Evaluation Survey

Informed consent was physically sought in the first learning meeting. The researcher created a 12-item questionnaire of 1 to 4 Likert scale. This was meant to collect quantitative data on what students thought about the flipped classroom model and the traditional lecture model. Item 1 was about out of class preparations, item 2 was about learning pace, item 5 and 6 focused on student' preference and satisfaction, item 4 and 12 were concerned with instructional engagement, and item 3 and 7 focused on knowledge while 5, 8 and 9 focused on thinking skills. The questionnaire was administered at the end of the flipped learning period (see table 3.2, Appendix 11 & 18).

Table 3.2. Questionnaire.

Research items	Strongly Disagree	Disagree	Agree	Strongly Agree
Scale	1	2	3	4
1. E-lectures compelled me to prepare for the class.				
2. E-lectures assisted me learn content at my own pace.				
3. In-class quiz and subsequent discussions broadened my view of concepts.				
4. Peer-peer interaction helped me learn faster.				
5. Self-directed learning and in-class problem solving is more effective than class lecture and subsequent problem solving at home.				

6. Active learning enhanced my problem-solving skills.				
7. Peer views of concepts improved my knowledge.				
8. Sharing my understanding improved my knowledge retention.				
9. Flipped instructional model improved my collaborative skills				
10. Flipped class saves time and resources e.g. (materials & tools)				
11. Online learning is relatively cheap in terms of internet costs and ICT hardware.				
12. Flipped classroom model increases student-lecturer interaction.				

3.3.2 Quizzes and Observation

Lecturer created assignments and quizzes were administered in each of the of the classes (Appendix 14, 15 & 17). The researcher assisted in the marking of the assignments. Qualitative data was collected through participatory class observation by the researcher (Appendix 7 & 8). The researcher attended all the classes and came up with a lecture observation report (see Table 3.3).

Table 3.3 Lecture Observation Report.

Lecture Observation Report	
Course	Fundamentals of EE

Study Program	EE
Date	
Topic	
Lesson Objectives: *By the end of this lecture, students should be able to;*	
Learning Materials	
Instructional Pedagogy	
General Evaluation of Class proceedings	
Lecturer Comments	

3.3.3 Questionnaire Validity and Reliability Tests

To ensure validity of the research items contained in the questionnaire, the researcher conveniently administered the questionnaire to flipped classroom experts before applying the same to the flipped cohort at the end of the study. The researcher adopted the Content Validity Ratio test pioneered by Lawshe, (1975) and is widely applied in both general and vocational education. The researcher calculated the Content Validity Ratio using the equation;

$$\text{Content Validity Ratio} = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}$$

Where n_e stands for the number of experts who checked "essential" or "useful, but not essential". N stands for number of expert respondents. Seven instructional pedagogy experts verified the questionnaire items. All items were unanimously considered relevant with a CVR of 1. All items had a favorable internal consistency reliability of greater than the minimum acceptable value of 0.70 as shown by the Cronbach's Alpha coefficient of 0.86.

3.4 Research Procedures

3.4.1 Traditional Classroom

Both classes were exposed to the traditional lecture model. Each class was taught by the same lecturer. Class B learnt using the TC model in the first three weeks and class A was sequentially exposed to the same lecture model in three weeks that followed. The researcher observed all

lectures. Students first interacted with the learning materials in class. Lecturer incentivized inquiry-based learning. Students paid attention as they were exposed to the new materials. At the end of each and every lecture, students were assigned homework which they completed outside class. The homework was due for submission before coming to class. Before the commencement of each lecture, lecturer revised with the students the previously assigned homework.

3.4.2 Flipped Classroom

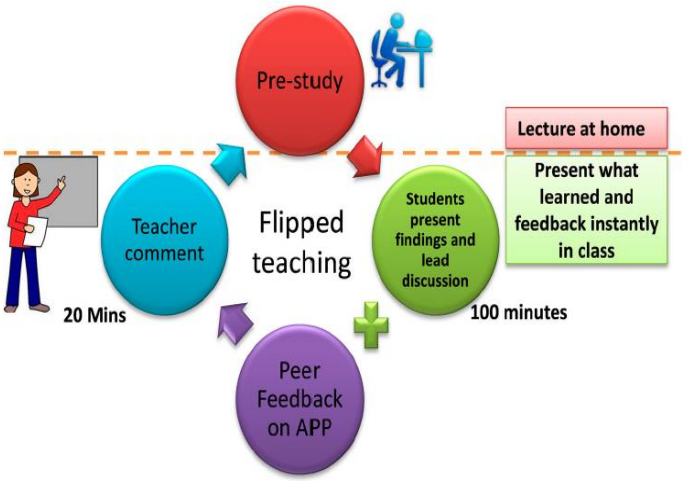


Figure 3.1. Weekly flipped class procedures.

a. Before Class

Students interfaced with the learning materials before attending class. Learning materials were accompanied with compulsory assignments that were due for presentation (see figure 3.1). Students had options to prepare at campus or off-campus. Most students preferred on-campus preparation as internet was ubiquitously available. Learning materials and presentation assignments were retrieved through multiple links namely WhatsApp, spot.upi.edu and Khan Academy. The lecturer posted and interacted with the students through the mentioned

platforms. Learning videos were 10-15 minutes in length. Online assignments and questions were submitted through the mentioned communication platforms for marking before the next learning meeting. Performance feedback was transmitted through the same communication platforms.

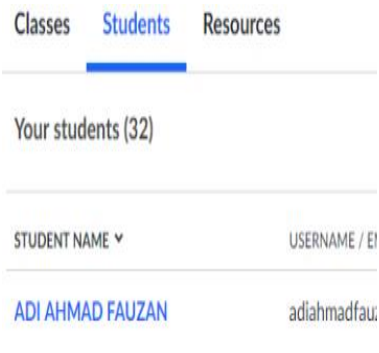
b. In-class

To initiate collaborative learning (peer to peer interaction and small group discussions), the lecturer superintended students' presentations. Each group presented on how their assigned circuit component works. Students were supplied with links to retrieve the YouTube embedded videos. Three groups were awarded 100 minutes for the discussion of their respective presentations and each presentation was worth 20 min. (see figure 3.1). Students were also free to supplement the allocated learning visual material with alternative types of material. The lecturer's input was frequently sought following presentations and discussions. To keep the students on track and motivated, the lecturer made evaluative comments and discussed gray

areas. Lecturer facilitated and engaged students in either one on one style or group format.

c. After Class

The lecturer assigned students extended work which required them to think critically, replay learning videos and review supplementary materials (see figure 3.2B). Lecturers evaluated active learning and self-directed learning. The evaluation informed the lecturer on how to improve next learning videos. Lecturer prepared learning videos, compiled associated learning materials and students received the learning materials at most three days before the next class meeting. At the end of the flipped learning period, an evaluative survey was administered.



A. Khan Academy Student Accounts.

B. Students Preparation

Figure 3.2. (A) Khan Academy Extract (B) Student Preparation.

3.5 Data Analysis

The researcher used the survey findings to evaluate students in terms of; preference and satisfaction, out of class preparation, instructional engagement, learning space and cognitive skills formation. To establish the relevance of flipped learning on students' performance, the researcher conducted a factorial analysis (2-way ANOVA) and two-sample t-test for paired (matched) data. SPSS 22.0 was used to process the quantitative data. The researcher also

produced lecture reports of each learning meeting. All lecture reports were also validated by the lecturer.